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NASA TM X-71073

**Cyg X-1: A RETURN TO THE PRE-1971
INTENSITY LEVEL
AND A 5.6-DAY MODULATION**

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(NASA-TM-X-71073) CYG X-1: A RETURN TO THE
PRE-1971 INTENSITY LEVEL AND A 5.6-DAY
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Cyg X-1 exhibited three pronounced x-ray intensity increases during 1975. The last of these, unlike the prior two, has not rapidly decayed back to its pre-increase value. Such a persistently high emission level from Cyg X-1 has not been observed since the source "transition" in 1971¹.

The Ariel-5 All-Sky Monitor experiment has monitored Cyg X-1 quasi-continuously since its launch in October 1974. No flare-like increases were observed until April 1975, when the source suddenly increased to an intensity level in excess of that of the Crab Nebula. The rise², maximum³ and decay⁴ were marked by considerably more variability on timescales of hours or more than was the relatively quiescent pre-increase temporal record. A smaller increase was reported in September⁵, which displayed the same variability and e-folding decay time of the order of 1 week. The third increase in November^{6,7} was to the level of the April event, displaying the same variability. It did not, however, decay over the same timescale⁸, and has shown no sign of decay after three months. Figure 1 displays the daily averages of the Cyg X-1 data accumulated between launch and 31 January 1976 by the All-Sky Monitor.

A 5.6-day modulation synchronized with HDE226868 was observed over the first six months of All-Sky Monitor data accumulation prior to the April increase⁹, but was not detectable immediately afterwards. We report here the detection of a similar 5.6 day modulation in the "high-state" data obtained over the three-month interval November 1975 - January 1976. The folded data from both the six months prior to the

April 1975 flare and the new three-month interval are displayed in Figure 2, where we have used the ephemeris of Ref. 10 to define the epoch of superior conjunction. The folds are in five bins, with the ordinate for each bin defined as the source intensity relative to the average of the four bins excluding superior conjunction. This average value for the new data is more than twice that of the pre-April 1975 measurements.

The light curve decrement (i.e. that fraction of the total source emission over one 5.6-day cycle which is deficient at superior conjunction) is $.019 \pm .003$ for the lower trace of Figure 2, compared to $.029 \pm .004$ for the upper trace. This level of modulation was not detectable in the All-Sky Monitor data between the April and November flares, which may have been the result of uncorrelated source intensity variations masking the effect. (the experimental value of decrement was $.008 \pm .009$ during this time interval). Daily averages for the April, September and November-January increases are displayed in Figure 3, combined with a 5.6-day grid from the ephemeris of ref. 10. It is obvious that the uncorrelated intensity variations prevent the direct observation of the reported level of 5.6-day modulation over individual cycles in general, and the effect can only be convincingly demonstrated by averaging over many cycles.

In ref. 9 it was suggested that the modulation observed prior to the April flare might be associated with the build-up to the increase, and might only be observable just before such increases. The new results

Figure Captions

1. Daily averages for more than one year of All-Sky Monitor measurements of Cyg X-1. The ordinate is natural for the experiment, with the Crab Nebula giving ~ 1.2 in the same units.
2. Data taken prior to the April 1975 increase (upper trace) and after the start of the November 1975 increase (lower trace) folded in 5 bins using the HDE 226868 ephemeris of ref. 10.
3. Daily averages at the times of the three 1975 increases, with a superposed HDE 226868 superior conjunction grid. On a finer timescale, the asynchronous intensity variations are even larger than those reflected in the plotted daily averages.

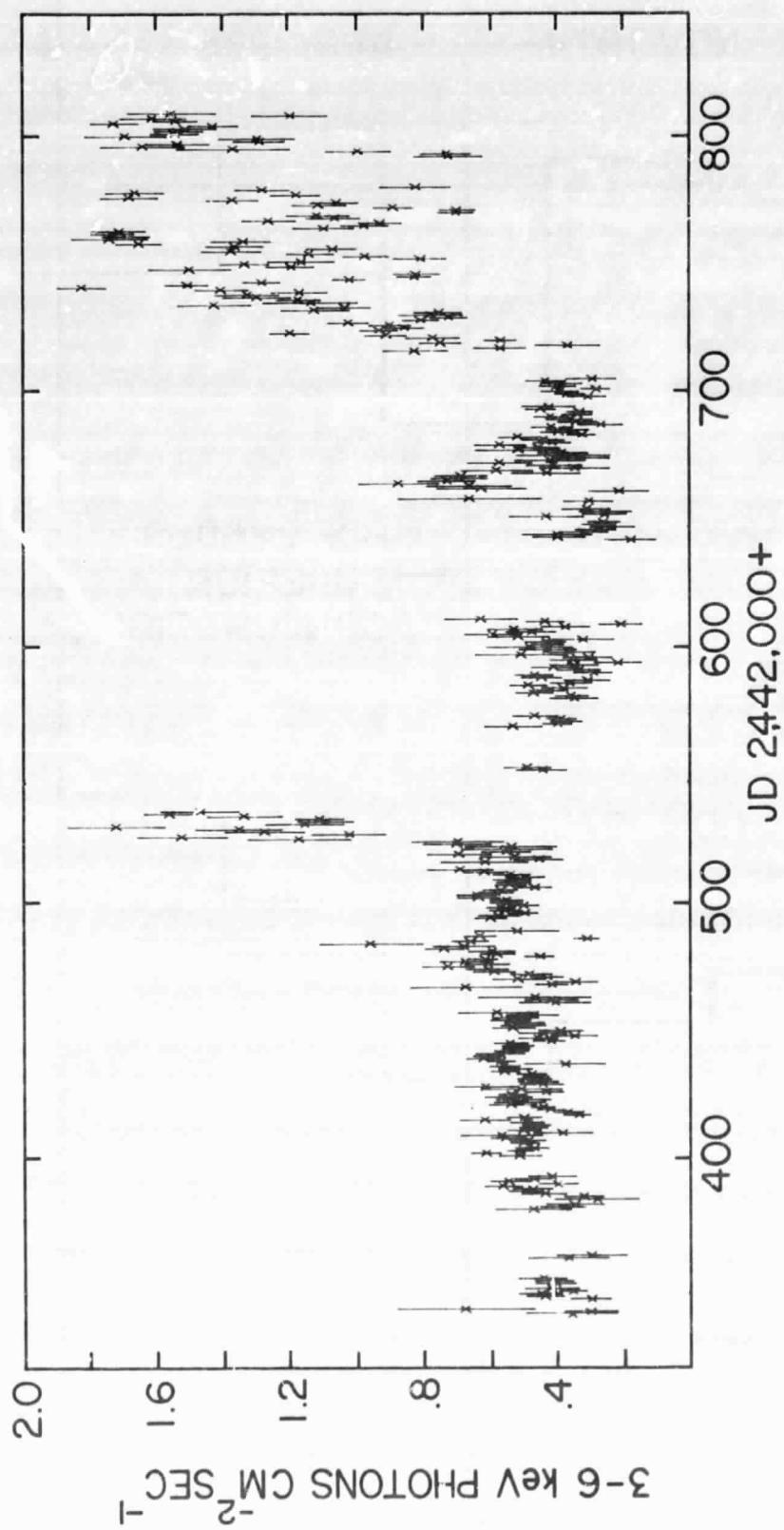


Fig. 1

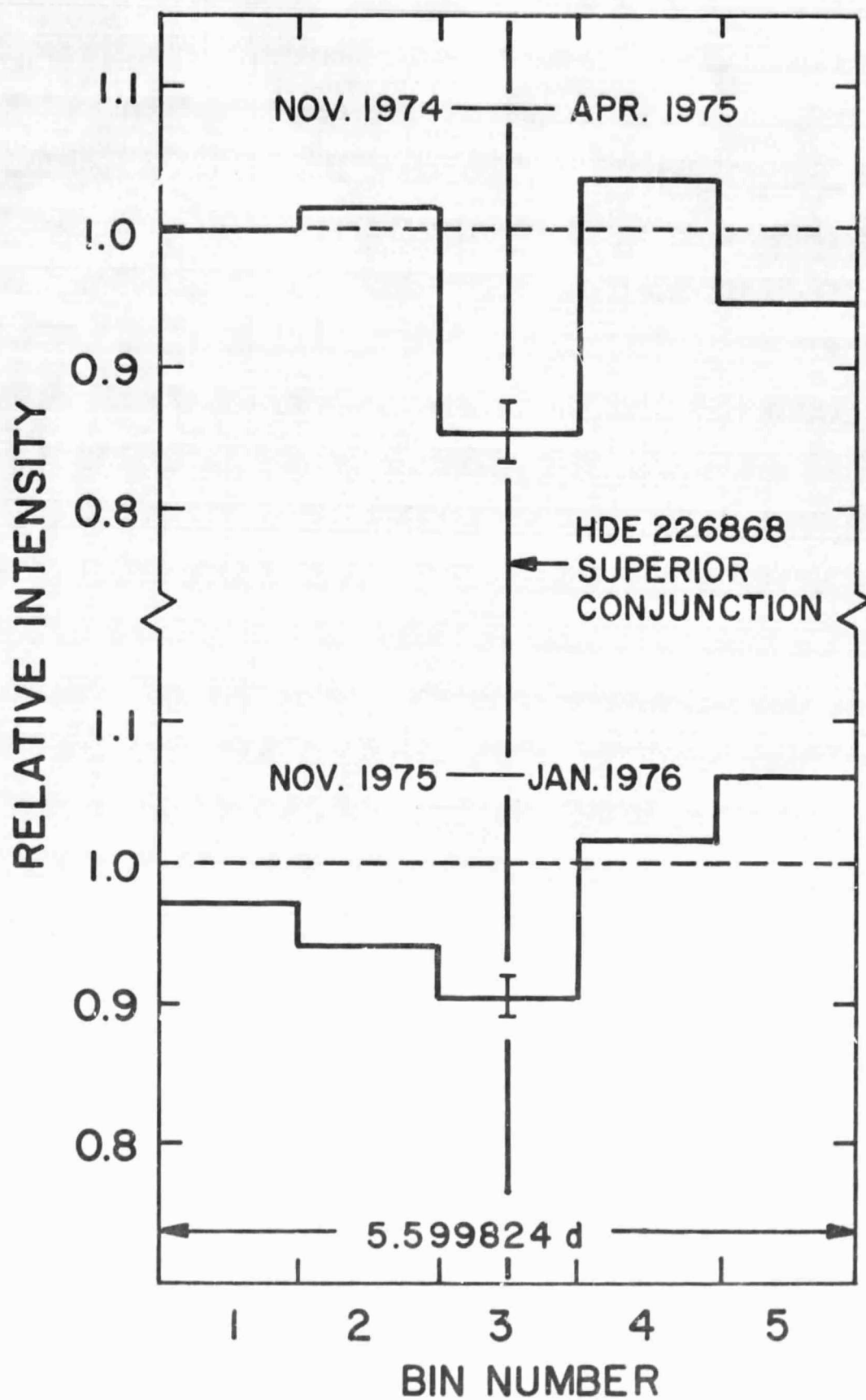


Fig. 2